How Do You Measure That Ceramic Property?

Jonathan Salem[1]; John Helfinstine[2]; George Quinn[3]; and Stephen Gonczy[4]

[1]. Mechanics and Life Prediction Branch, NASA GRC, Cleveland, OH; [2]. Retired Corning Inc, Big Flats, NY; [3]. American Dental Association Foundation, NIST, Gaithersburg, MD;. [4]. Gateway Materials Technology, Inc., Mt. Prospect, IL

Introduction

By using the dozens of consensus test standards and practices developed by the Advanced Ceramics Committee of ASTM, C-28, the measurement of mechanical, physical, thermal, and performance properties can be properly performed. The "what, how, how not, and why" are clearly illustrated for beginning as well as experienced testers. Using these standards will provide accurate, reliable, and complete data for rigorous comparisons with other test results. The C-28 Committee has involved academics, and producers, and users of ceramics to write and continually update more than 45 standards since the committee's inception in 1986.

For further information

The C28 Committee and Standards for Ceramics
ASTM C28 Committee Page –
http://www.astm.org/COMMIT/C28.htm

List of C28 Subcommittees and Links to Standards-
http://www.astm.org/COMMIT/SUBCOMMIT/C28.htm

ASTM C28 Advanced Ceramic Standards by Subject-
http://www.astm.org/COMMIT/CUSTOM1/C28.htm

Chart showing ASTM C28 Advanced Ceramic Standards-
http://www.astm.org/COMMIT/C28_Standards.pdf

ASTM Standards for Advanced Ceramics, Whitewares, Glass, and Ceramic Tile-
http://www.astm.org/Standards/glass-and-ceramic-standards.html

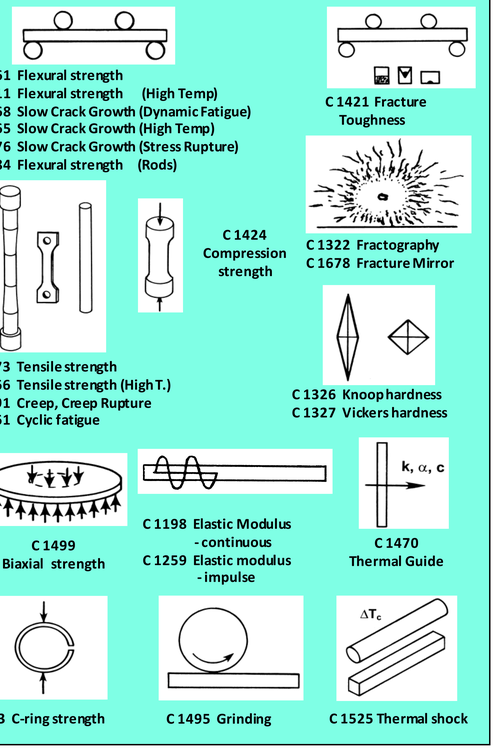
Acknowledgments

We thank the more than 90 industry, government, and academic committee members from many countries (~25% non-USA) who have volunteered many hours to develop these standards via work in six technical and four administrative subcommittees.

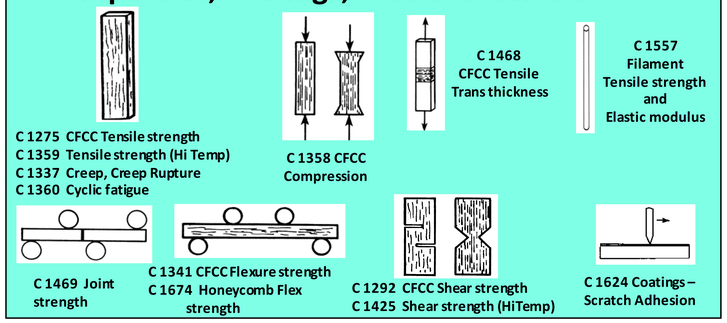
C28 Advanced Ceramic Standards

Visit the C28 website (http://www.astm.org/COMMIT/COMMITTEE/C28.htm) to purchase C28 standards or join the C28 committee.

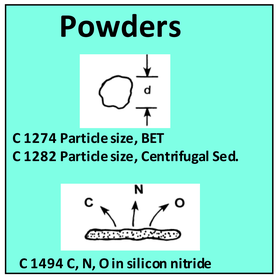
Monolithics



Composites, Coatings, Porous Ceramics



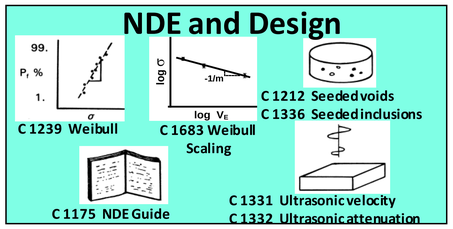
Powders



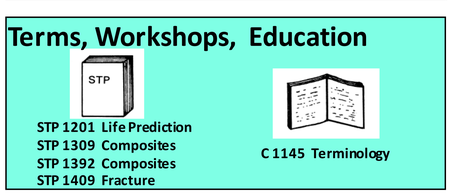
Subcommittees

.01 Mech. Prop. + Reliability
.03 Physical Prop. + NDE
.04 Applications
.07 Ceramic Matrix Composites
.91 Terminology
.94 ISO TAG

NDE and Design



Terms, Workshops, Education



ASTM C28 standards are found in Vol. 15.01.

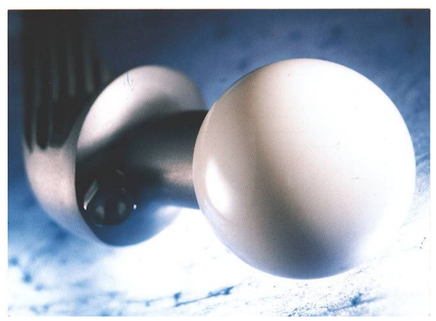
7-2010

Standardization: Tangible Benefits

F 1973: Standard Specification for High Purity Dense Yttria Tetragonal Zirconium Oxide Polycrystal (Y-TZP) for Surgical Implant Applications

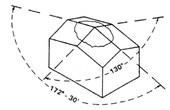
ASTM Committee F-04, Surgical and Medical Devices and the U.S. Food and Drug Administration used generic C-28 Advanced Ceramics for their new standard

"The average flexural strength shall be 800 MPa or greater by 4 point bending in accordance with ASTM C 1161"
"The minimum elastic modulus shall be 200 GPa in accordance with C 1198 or C 1259"
"If Weibull modulus is tested, it shall be tested in accordance with C 1239"

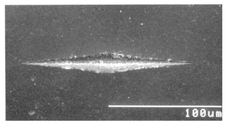


Standardization: Tangible Benefits

Hardness Testing of Ceramics



The Knoop diamond pyramid indenter.



A Knoop indentation in a ceramic.

- Hardness standards for metals such as ASTM E 384 were often applied to ceramics. This led to problems since cracking and the indentation size effect in ceramics caused users to vary the testing conditions dramatically. As a result, it was very difficult to compare ceramic hardness values. This was a severe problem since material specifications were being written for ceramics with hardness requirements.
- Furthermore, the Harmonized Tariff Schedule of the United States classified imported ceramic wares in part by hardness, but with the archaic Mohs mineralogical scratch test.
- ASTM Knoop and Vickers ceramic hardness tests were adopted in 1996. An ISO test was adopted in 2000. The procedures are harmonious.
- NIST developed ceramic Knoop and Vickers hardness SRM's that complement the test method standards. Confusion has been eliminated and data quality has improved dramatically.
- The US Customs service acquired two Knoop SRM's disks and is working through NAFTA to replace the Mohs specifications with modern Knoop hardness specifications.